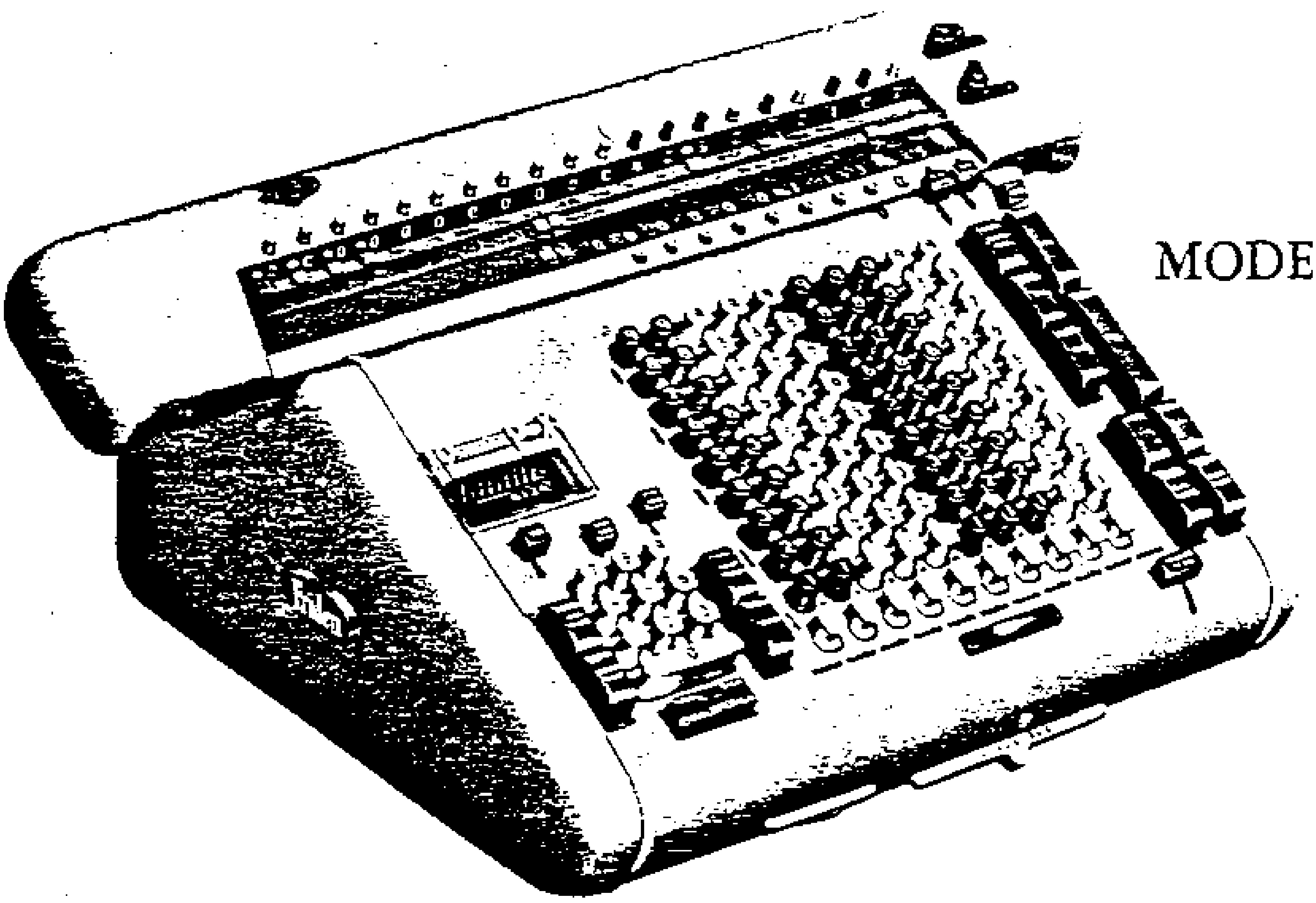
Friden CALCULATING MACHINE

MECHANICAL OPERATIONS MANUAL



MODEL SBT

Friden, Inc.

SAN LEANDRO, CALIFORNIA

PLANTS IN
SAN LEANDRO, CALIFORNIA • ROCHESTER, NEW YORK
WAGENINGEN, HOLLAND • NIJMEGEN, HOLLAND
SALES AND SERVICE THROUGHOUT THE WORLD

PRINTED IN U.S.A.

PREFACE

This manual explains the mechanical operations of the Model SBT which is basically a Model ACG with these features:

- Back Transfer:
  A mechanical means for transferring the figures from the accumulator dials to the keyboard selecting levers, and from the selecting levers back to the accumulator dials.
- Selective Transfer Positioner:
  Provides the operator with a means of selecting the desired position for the 1 used in automatic transfer.
- Automatic Division Stop
- Automatic Transfer
- Enter Dividend in First Carriage Position
- Power Set of Add-Subtract Gate from Plus & Minus Keys
- Eleven Position Carriage Shift Rack:
  To allow Back Transfer from 20th Accumulator dial.
- Gradient Counter Control

The drawings and their explanations will lead you through a back transfer operation. Read the explanations, trace on the sketch, locate and trace on the machine.

Set up of machine: Carriage in 1st position, No. 2 tab stop depressed, add key up. Put 2345678900 in the keyboard and add to the accumulator dials. Operate the machine by hand crank while tracing.

CONTENTS

Page

Fig 1 Releasing of starting shaft 1
Fig 2 Keyboard clearance and releasing of selection holding pawls 2
Fig 3 Disabling of carriage clear and positioning of minus engaging arm 3
Fig 4 Holding of add-subtract gate and conditioning the floating tooth disc 4
Fig 5 Rotation of entry control gear and actuation of restore shaft 5
Fig 6 Positioning sensing fingers, dual tooth feed gears, and selecting arms 6
Fig 7 Positioning of blocking bail and transfer blocks 7
Fig 8 Positioning of auxiliary slides 8
Fig 9 Cycles of the drive shaft during back transfer 9
Fig 10 Restore of starting shaft and enter dividend key 10
Fig 11 Restore of blocking fingers and positioning of selection arms 11
Fig 12 Back transfer with zero tab stop depressed 12
Fig 13 No actuation of keyboard clear gate at the end of back transfer operation when add key is forward 13
Fig 14 Back transfer operation when no tab stop is depressed 13
Fig 15 Blocking of back transfer sensing fingers 14
Fig 16 Disabling of back transfer by individual column locks and from clutch releasing 14
Fig 17 Selective transfer position 15
Fig 18 Restoring of starting shaft from division stop lever 16
Fig 19 Counter blockout 17
Fig 20 Mult key restore 18
Fig 21 Power set of add-subtract gate 19

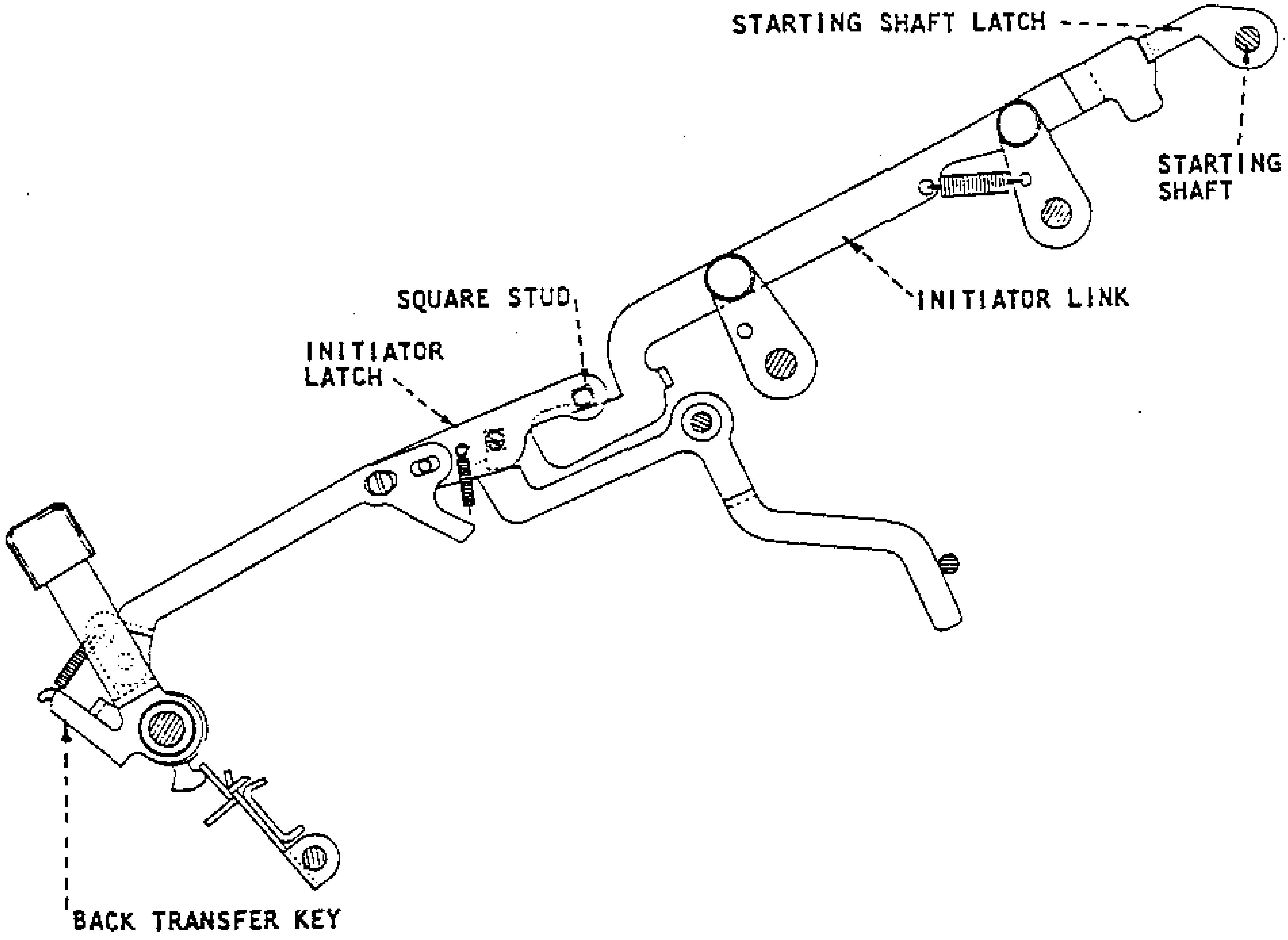


FIG 1. RELEASING OF STARTING SHAFT:

Pulling the back transfer key forward causes the square stud of the initiator latch to pull the initiator link from under the starting shaft latch. The starting shaft will be rotated by the starting shaft spring located at the left end of the shaft.

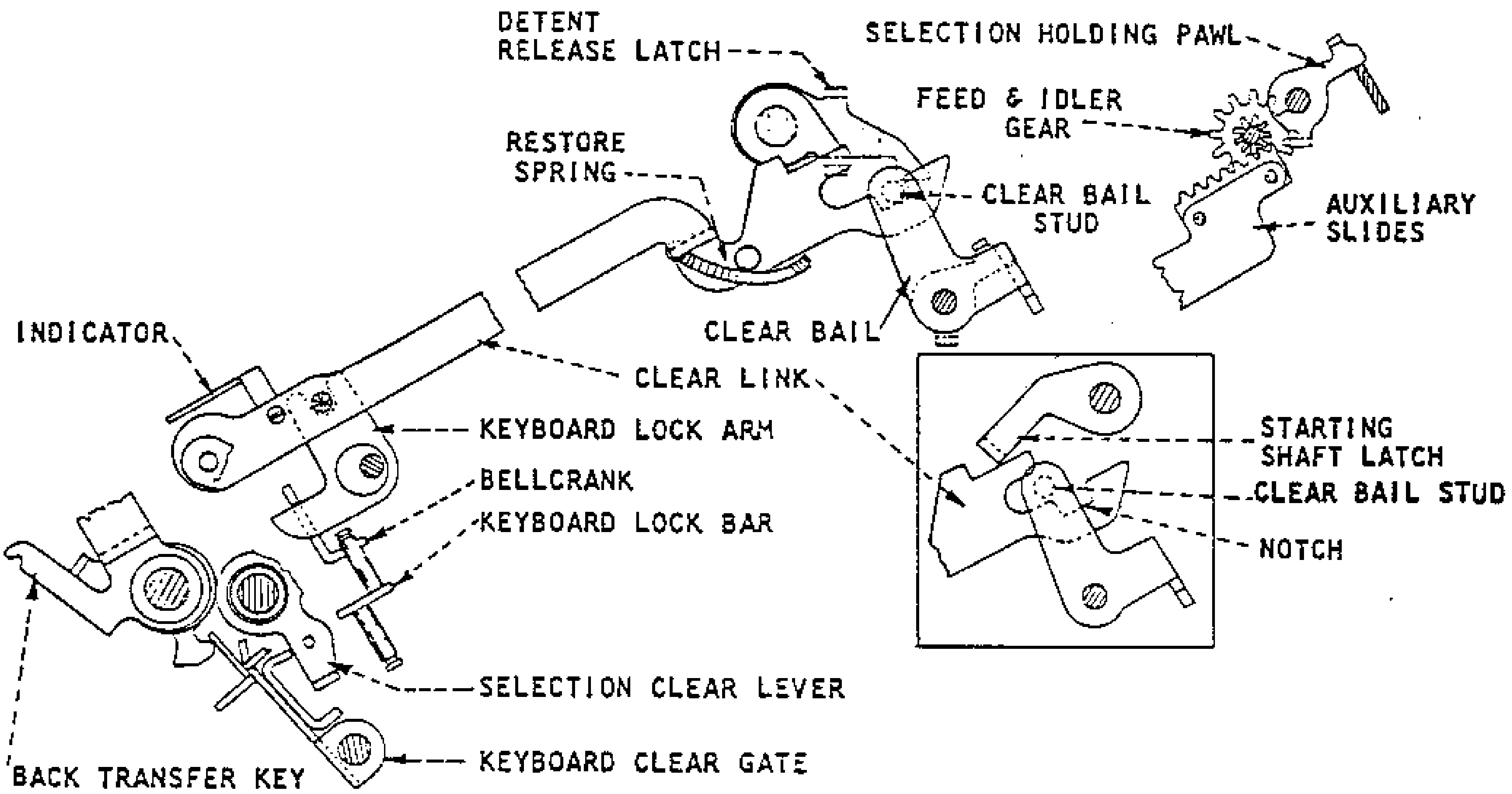


FIG 2. KEYBOARD CLEARANCE AND RELEASING OF SELECTION HOLDING PAWLS:

After a back transfer operation, the clear bail stud is positioned in the clear link notch. The following applies to the parts from this position.

Pulling the back transfer key forward causes the underside of the key to actuate the keyboard clear gate so the depressed selection keys are released prior to a back transfer operation.

The movement of the keyboard clear gate causes the selection clear lever to pull the clear link forward. The rear of the clear link pulls on the clear bail stud. The clear bail, which extends across the program unit, disengages the selection holding pawls from the feed and idler gears. The releasing of the feed and idler gears allows the restoration of all the auxiliary slides and the selecting arms that were positioned by a prior back transfer operation.

When the clear bail is actuated, the detent release latch drops by spring action behind the clear bail stud. The detent release latch holds the clear bail which holds the selection holding pawls disengaged from the feed and idler gears to give enough time for the auxiliary slides to restore prior to a back transfer operation.

The tripping of the starting shaft causes the starting shaft latch to depress the rear of the clear link so the notch is below the clear bail stud. See inset.

When the back transfer key is released, the clear link is pulled rearward by the restore spring. The clear link pivots the keyboard lock arm so the bellcrank actuates the keyboard lock bar to the right to lock the keyboard.

When the clear link moves rearward, an orange marked indicator is positioned so the orange is visible through a slot in the top cover to show there has been a back transfer operation. The orange is visible until either the keyboard clear key is depressed or the keyboard is cleared at the end of another operation when the add key is forward.

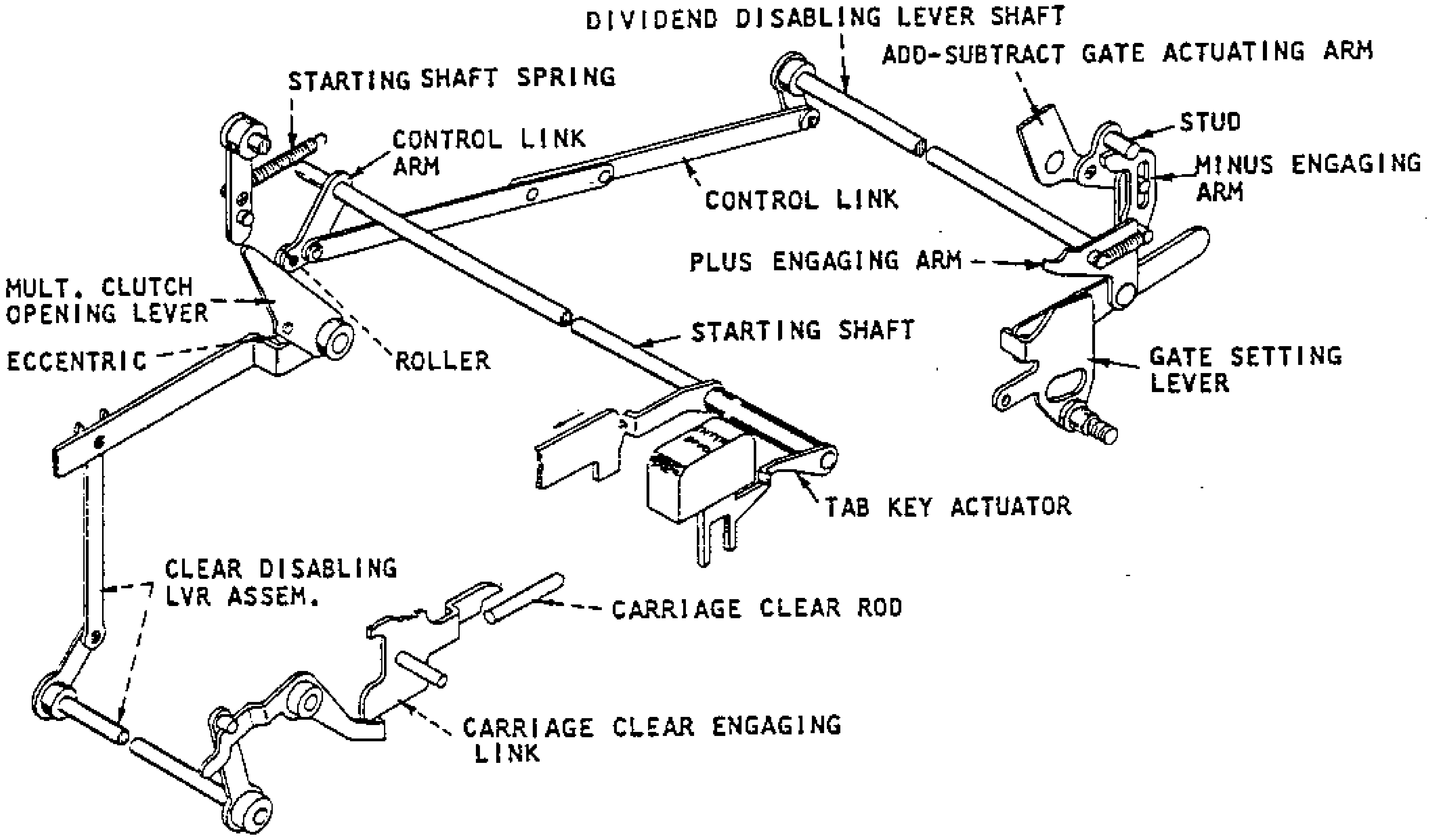


FIG 3. DISABLING OF CARRIAGE CLEAR AND POSITIONING OF MINUS ENGAGING ARM:

The rotation of the starting shaft:

1. Causes the control link arm to move the control link rearward. The control link rotates the dividend disabling lever shaft to position the minus engaging arm under the stud of the add-subtract gate actuating arm. The plus engaging arm is disengaged.

2. Causes the roller of the control link to actuate the mult clutch opening lever. This lever through its eccentric actuates the clear disabling levers assembly to disable the carriage clear engaging link from the carriage clear rod.

3. Causes the tab key actuator to depress the enter dividend key to place the machine in a tabulation operation. The machine will operate as in normal tabulation except that the accumulator dials will not be cleared and the add-subtract gate will be positioned in minus.

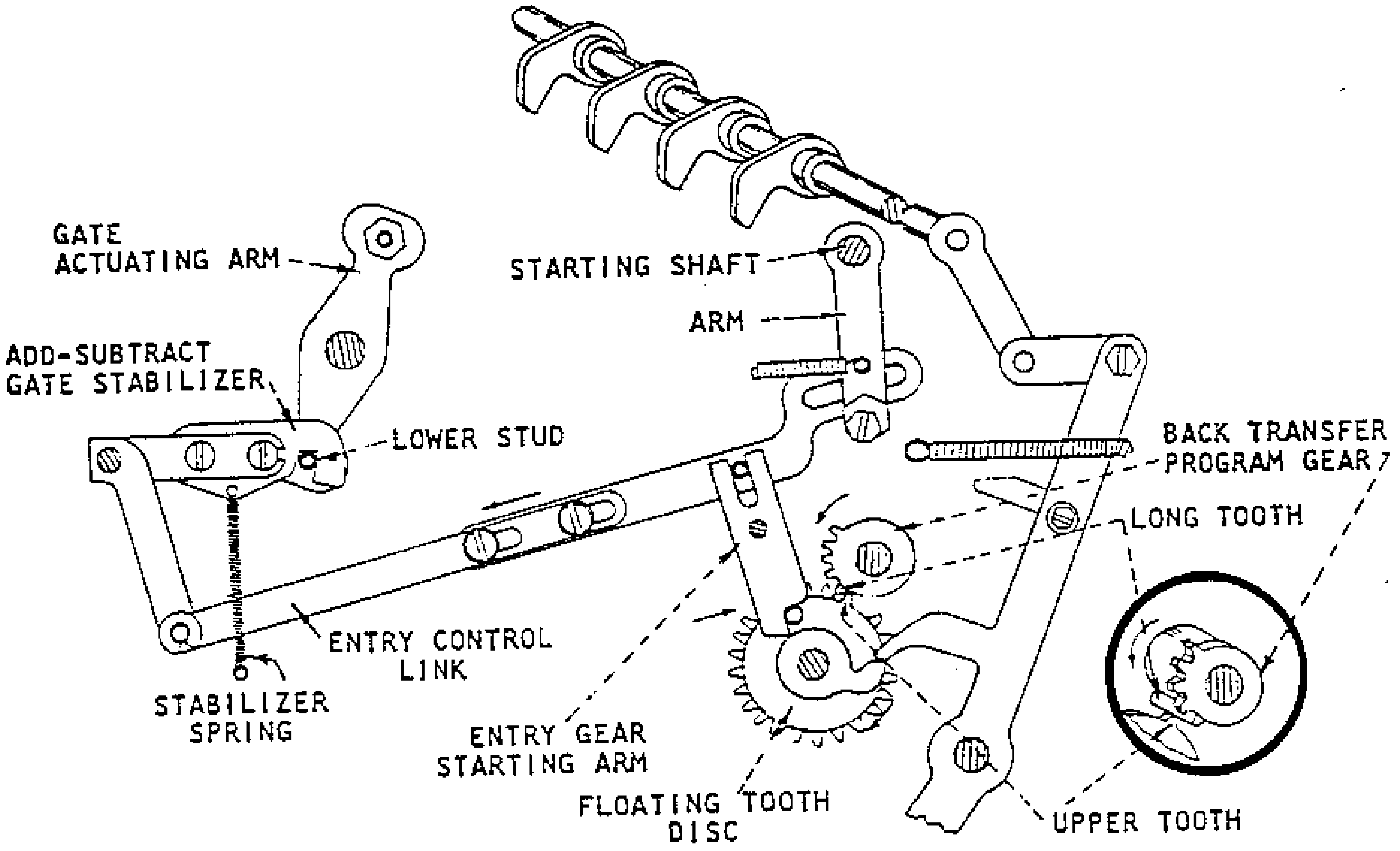


FIG 4. HOLDING OF ADD-SUBTRACT GATE AND CONDITIONING THE FLOATING TOOTH DISC:

The rotation of the starting shaft: (Continued)

4. Causes the arm on the left end to move rearward allowing the stabilizer spring to pull the add-subtract gate stabilizer against the lower stud of the gate actuating arm.

(Rotate the drive shaft by hand crank and stop when the gate is tripped in minus.) The stabilizer drops over the lower stud. At the time the stabilizer drops, the entry control link is moved rearward and pivots the entry gear starting arm. The entry gear starting arm moves the floating tooth disc clockwise so the upper tooth is positioned forward.

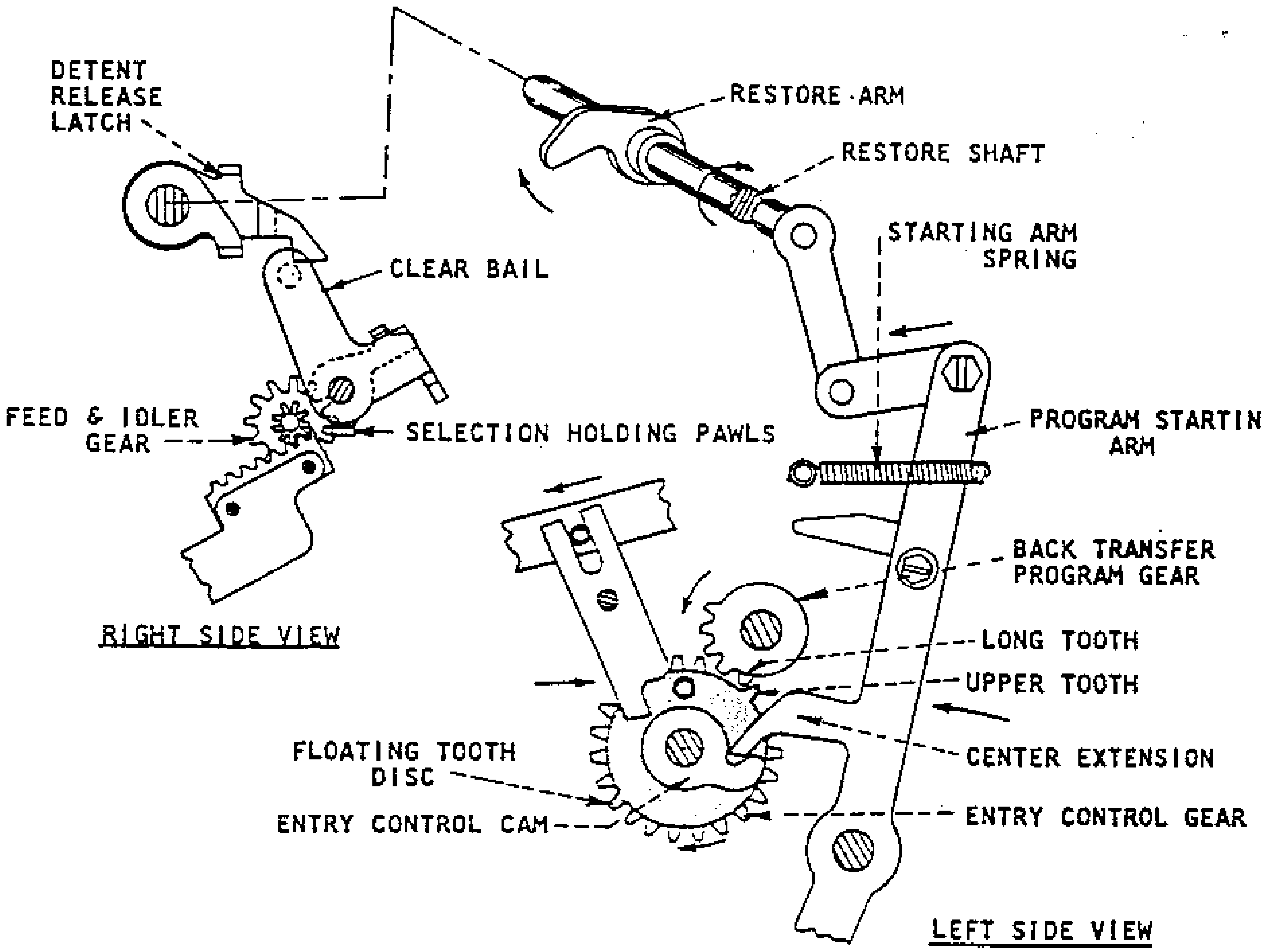


FIG 5. ROTATION OF ENTRY CONTROL GEAR AND ACTUATION OF RESTORE SHAFT:

Continued rotation of the drive shaft causes the back transfer program gear to bring its long tooth into contact with the upper tooth of the floating tooth disc and cause the entry control gear to rotate two tooth positions. This rotation moves the entry control cam from under the center extension of the program starting arm. The starting arm spring causes the upper end of the program starting arm to move rearward thus rotating the restore shaft which:

1. Causes the detent release latch at the right end of the restore shaft to release the clear bail so the selection holding pawls can engage the feed and idler gears.

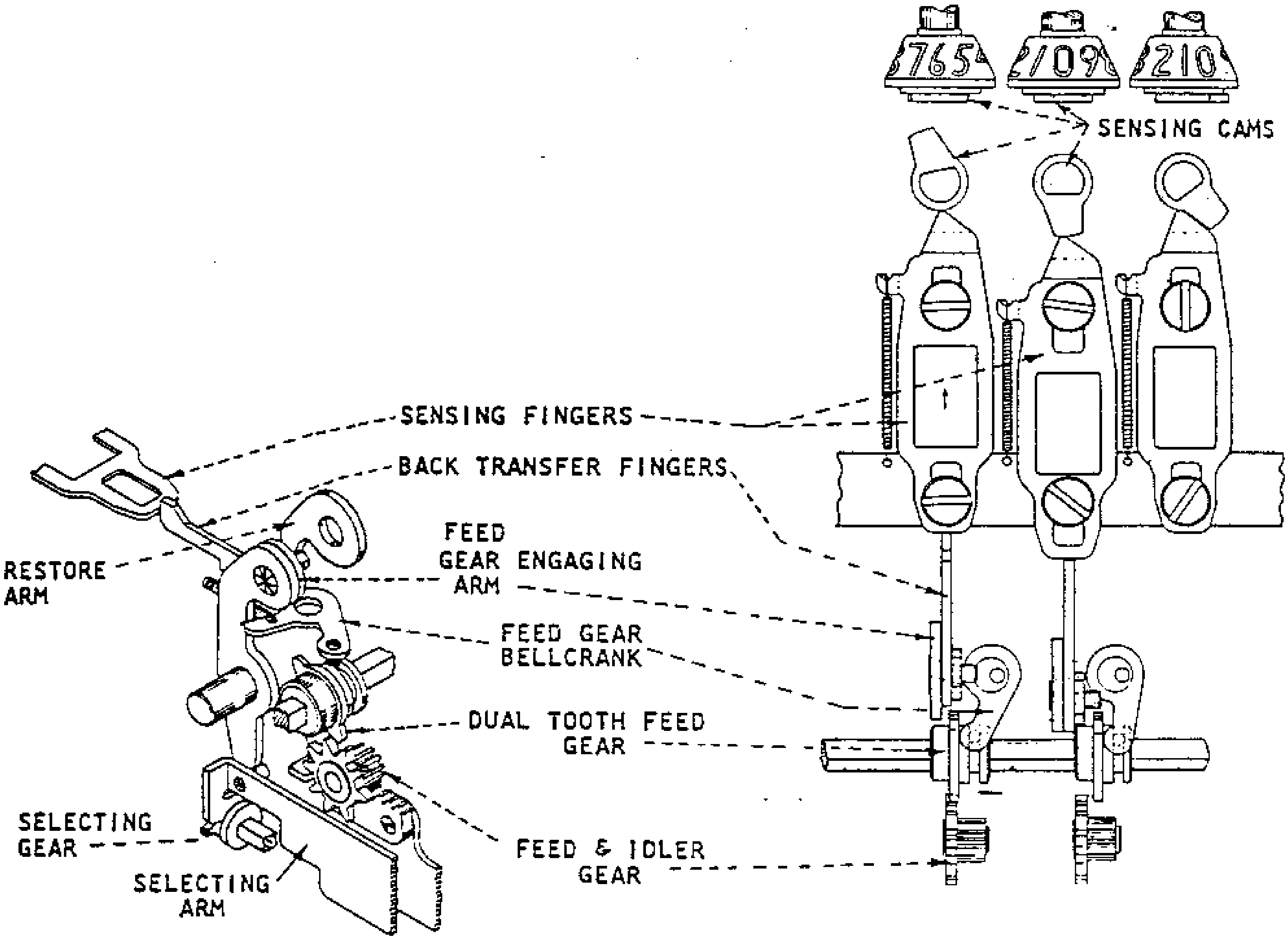


FIG 6. POSITIONING SENSING FINGERS, DUAL TOOTH FEED GEARS, AND SELECTING ARMS:

The restore shaft rotation: (Continued)

2. Causes the restore arms to raise allowing the feed gear engaging arms to move rearward by the spring tension of the feed gear bellcranks. Three more actions occur:

   a. The back transfer fingers move rearward and cause the sensing fingers to sense the sensing cams of the accumulator dials. When the dials are at zero, the sensing cams restrict the movement of the sensing fingers. When the dials show a figure, the sensing cams are out of position and allow the sensing fingers to move rearward to their full travel.

   b. The full travel of any sensing finger allows its feed gear engaging arm:

      1. To position a 1 to 5 selecting arm to the No. 1 selection position. This brings the selecting gear into alignment for contact by the number 1 selection tooth of the actuator segments.

      2. To allow a feed gear bellcrank to move its dual tooth feed gear to the left into mesh with a feed and idler gear.

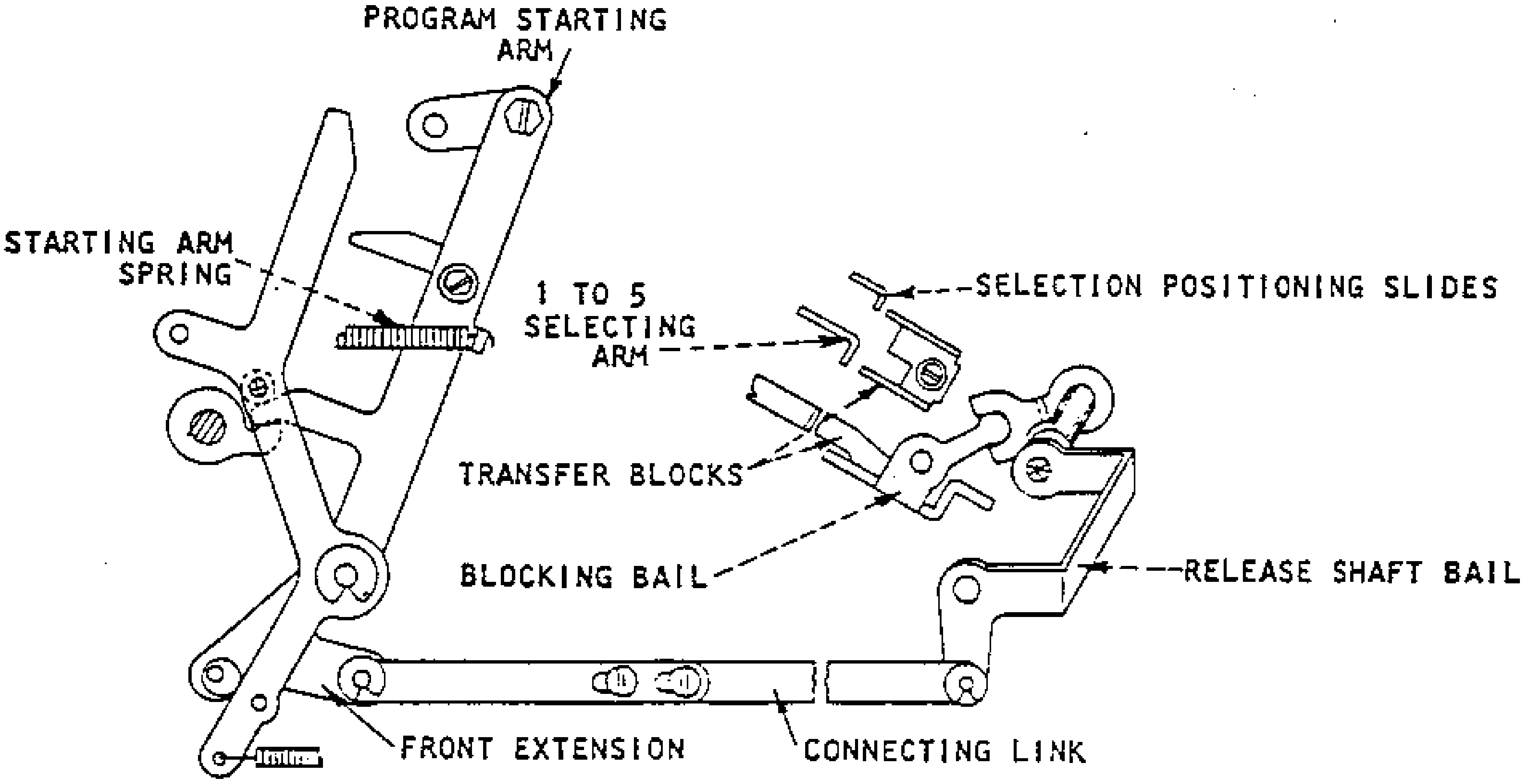


FIG 7. POSITIONING OF BLOCKING BAIL AND TRANSFER BLOCKS:

When the starting arm spring actuates the program starting arm, the front extension at the lower end moves forward. This causes the connecting link to rotate the release shaft bail so the blocking bail raises the transfer blocks. Each transfer block has two sides, the right side positions in front of the selection positioning slides; the left side positions in front of the 1 to 5 selecting arm. Because the transfer blocks raise into blocking position slightly before the 1 to 5 selecting arms move to the 1 selection position, the possibility of more than a 1 selection is eliminated.

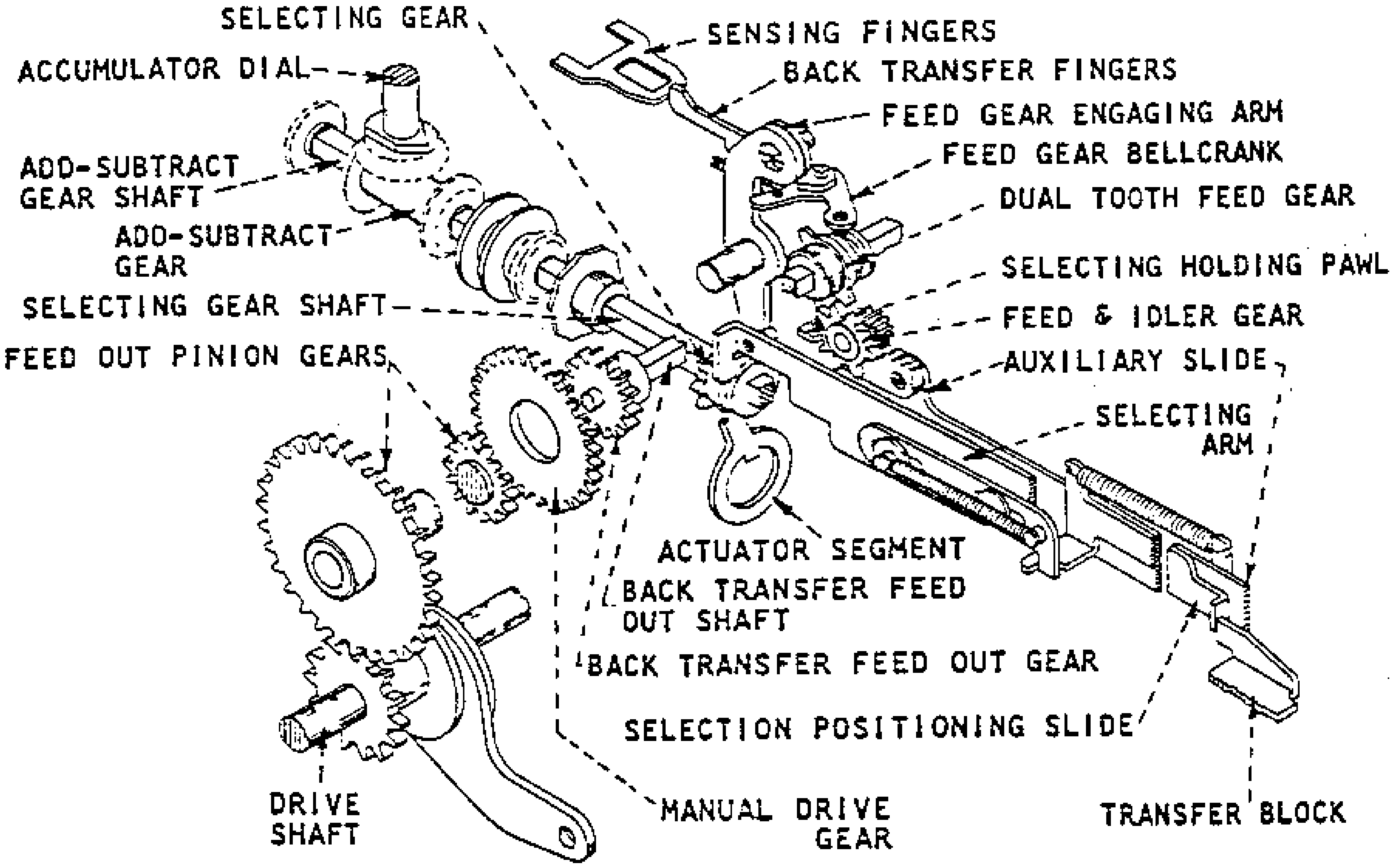


FIG 8. POSITIONING OF AUXILIARY SLIDES:

The add-subtract gate is positioned in minus so the add-subtract gears are in mesh with the accumulator dial gears; the 1 to 5 selecting arms are positioned; the dual tooth feed gears are in mesh with the feed and idler gears.

Each cycle of the drive shaft:

1. Causes the subtraction of one digit from those accumulator dials showing figures. This is accomplished by the actuators rotating the selecting gears, the selecting gear shafts, the add-subtract gear shafts, and the add-subtract gears.

2. Causes the rotation of the feedout pinion gears, the manual drive gear, and the back transfer feedout shaft which turns the dual tooth feed gears. The dual tooth feed gears rotate the feed and idler gears which move the auxiliary slides forward one selection position when a digit is subtracted from the accumulator dials.

   The forward motion of an auxiliary slide stretches the spring to the selection positioning slide because the selection positioning slide is blocked by the transfer block. The auxiliary slide is held from restoring by the selecting holding pawl.

   The maximum movement of any auxiliary slide is to the ninth selection position. When an accumulator dial reaches the zero position, the sensing cam moves the sensing finger forward which moves the back transfer finger forward to restore the feed gear engaging arm. The feed gear engaging arm:

   a. allows the selecting arm to restore, and
   b. causes the feed gear bellcrank to disengage the dual tooth feed gear from the feed and idler gear.

The auxiliary slide remains at the selected position because of the selection holding pawl. The selecting arms are not positioned to the selection position corresponding to the figures that were in the accumulator dials because the selection positioning slides are held by the transfer blocks.

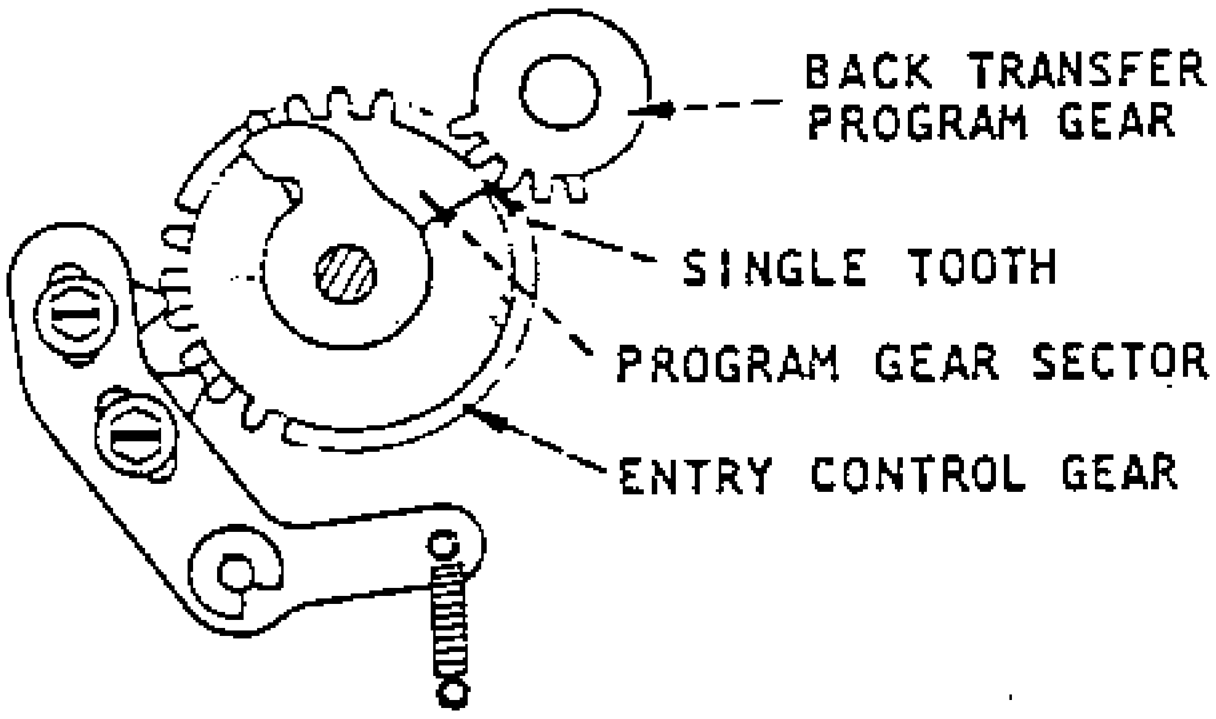


FIG 9. CYCLES OF THE DRIVE SHAFT DURING BACK TRANSFER:

During the first cycle of the drive shaft after the back transfer program gear picks up the entry control gear, the machine is conditioned for back transferring. During the second through the ninth cycles, the figures are transferred from the accumulator dials. The tenth cycle terminates the back transfer operation.

The entry control gear turns two teeth for each of the one through eight cycles, turns four teeth for the ninth cycle, and turns five and a half teeth during the tenth cycle.

At the beginning of the ninth cycle, the long tooth of the back transfer program gear turns the entry control gear two teeth. This brings the single tooth of the program sector gear into mesh with the outside teeth of the back transfer program gear to cause an extra two teeth rotation of the entry control gear.

The extra two teeth rotation is to advance the entry control gear so it is in position to terminate the back transfer operation at the right time.

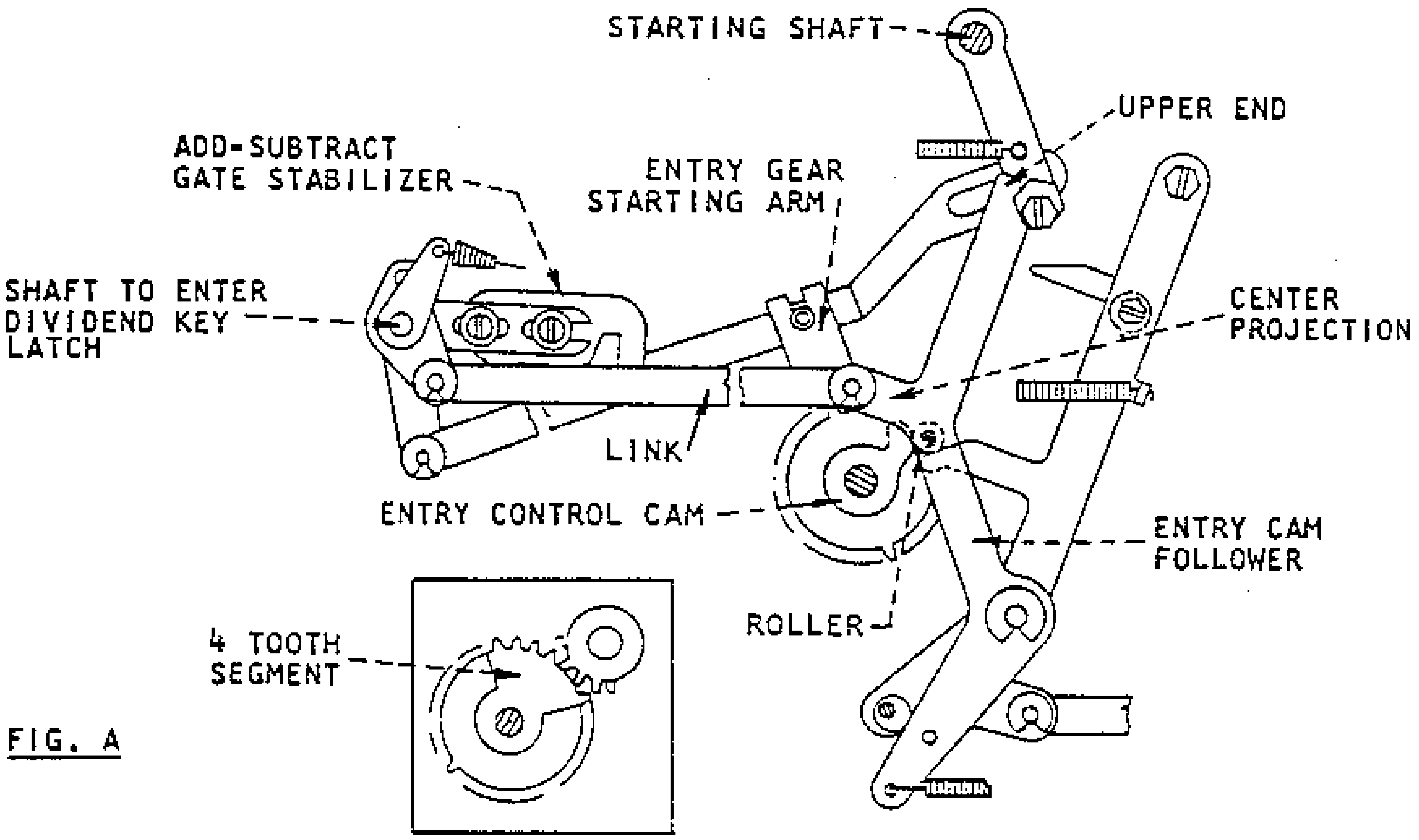


FIG. A

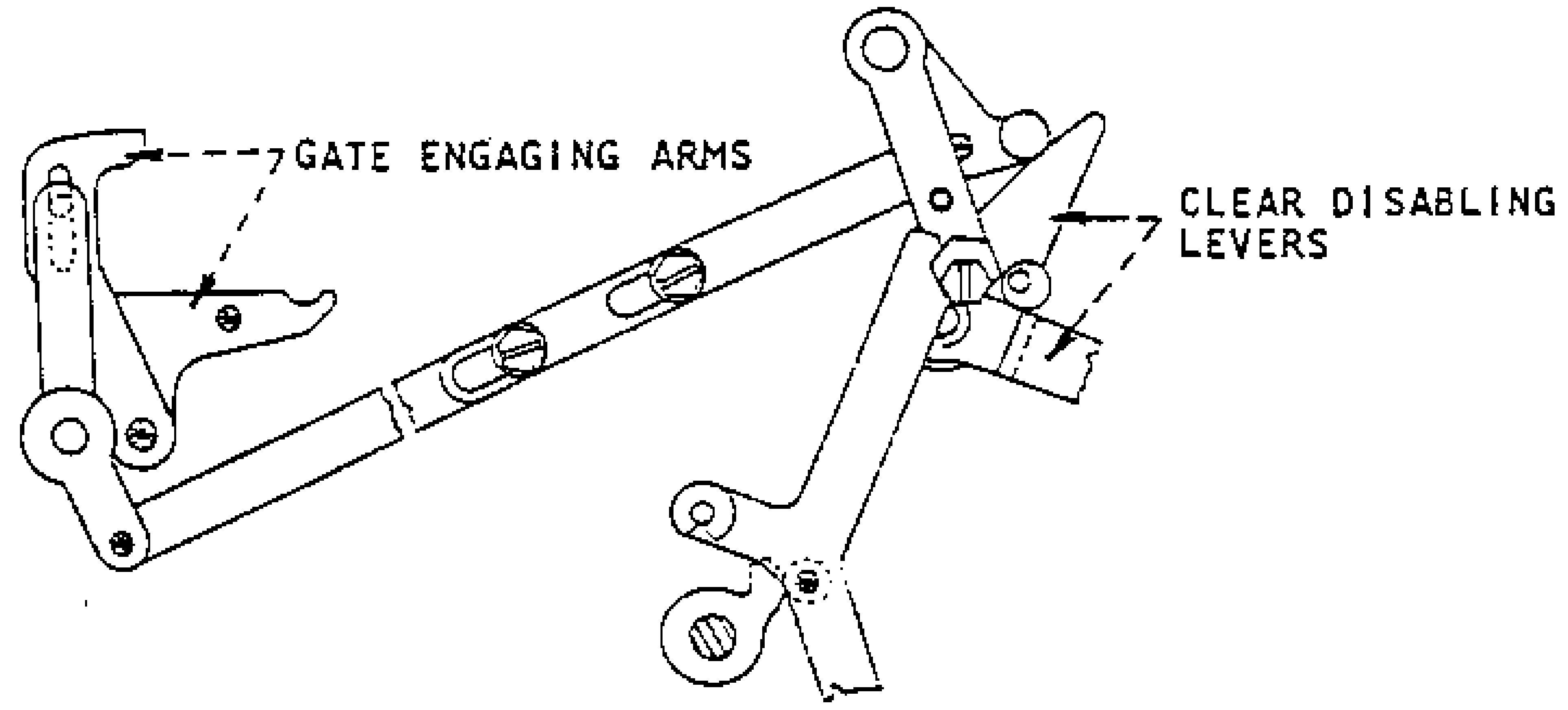


FIG. B

FIG 10. RESTORE OF STARTING SHAFT AND ENTER DIVIDEND KEY:

During the tenth drive shaft cycle, the entry control gear is rotated five and a half teeth to allow the entry control cam to move the entry cam follower forward to cause the termination of the back transfer operation. The long tooth of the back transfer program gear turns the entry control gear so the outside teeth of the back transfer program gear picks up the four tooth segment of the program sector gear, inset. As the four tooth segment is rotated, the entry control cam moves the entry cam follower forward by contact with a roller. The forward movement causes these actions:

1. The upper end restores the starting shaft which in turn restores:
    - a. Fig A, the add-subtract gate stabilizer and the entry gear starting arm.
    - b. Fig B, the clear disabling levers.
    - c. Fig B, the gate engaging arms on right side of machine.
2. Fig A. The center projection pulls a link to rotate the shaft that actuates the latch for the enter dividend key so the key can restore.

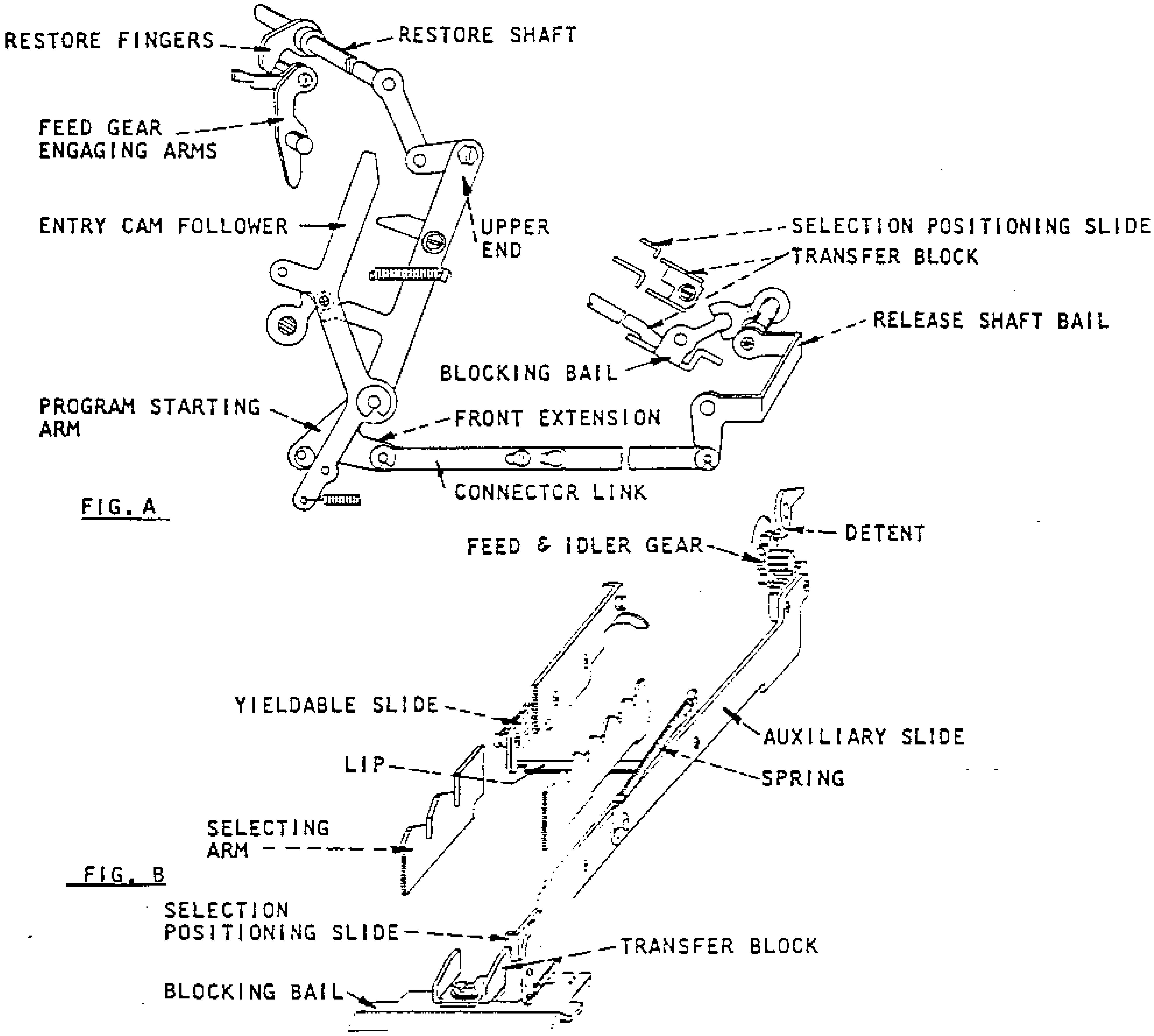


FIG. A

FIG. B

FIG. 11. RESTORE OF BLOCKING FINGERS AND POSITIONING OF SELECTION ARMS:

The forward movement of the entry cam follower continued.

3. The lower end actuates the program starting arm which causes:

   a. The front extension Fig A, to pull the connector link rearward to rock the release shaft bail, so the blocking bail can be actuated downward. The blocking bail movement disengages the transfer blocks from the selection positioning slides of the auxiliary slides. Those selection positioning slides of the auxiliary slides that have been positioned by figures transferred from the accumulator dials will snap forward by spring action. The lips of the selection positioning slides Fig B, will pick up and position the selecting arms to the selection positions corresponding to the figures transferred from the accumulator dials.

4. The upper end causes the rotation of the restore shaft so the restore fingers restore the feed gear engaging arms to home position.

Because the enter dividend key has restored, the clutch will open when the drive shaft reaches home position thus completing the back transfer operation.

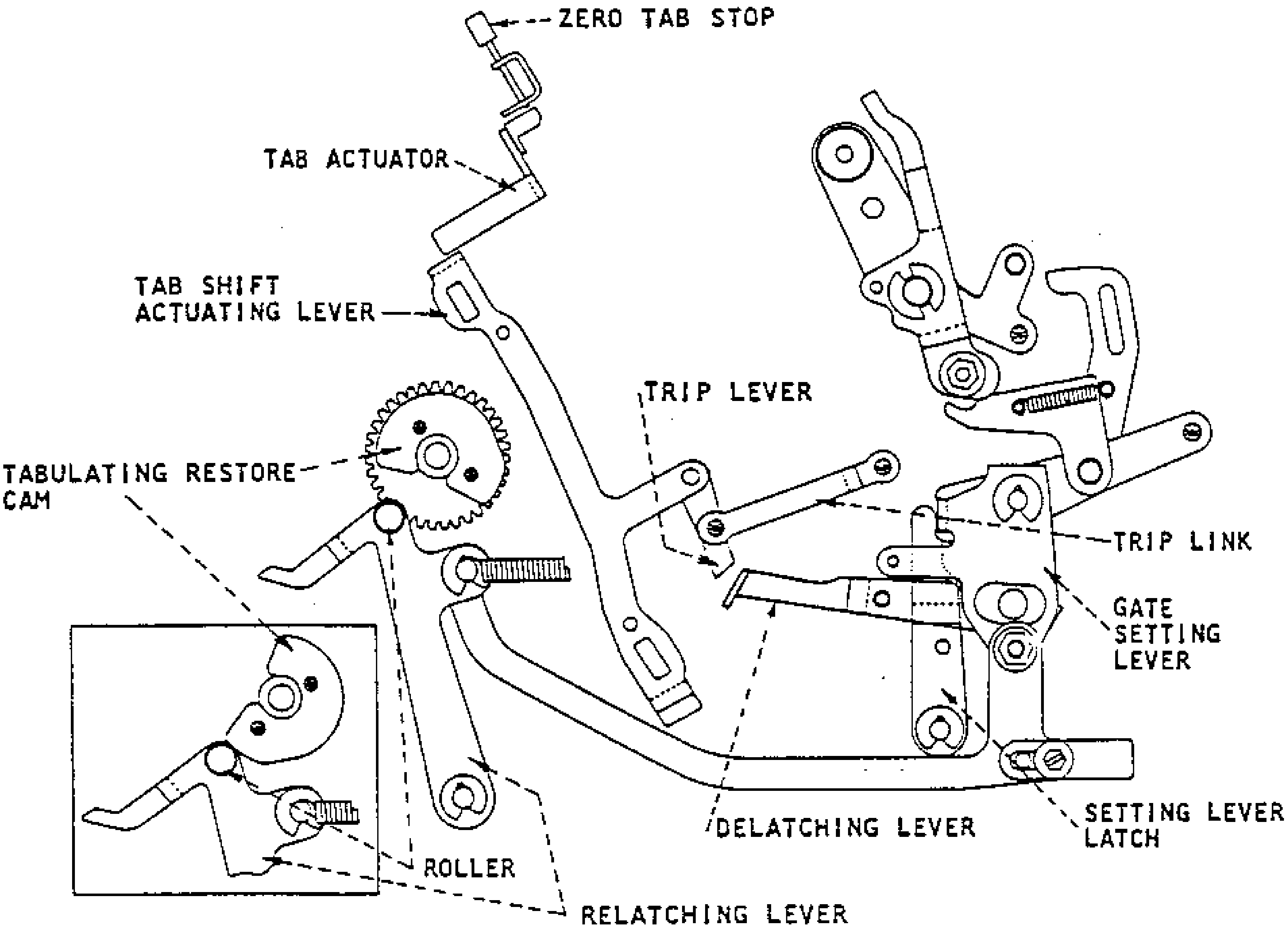


FIG 12. BACK TRANSFER WITH ZERO TAB STOP DEPRESSED:

When the zero tab stop is depressed and the machine is operated in back transfer, the carriage will remain in first position.

Because the zero tab stop is depressed, it will be holding down the tab actuator and the tab shift actuating lever which in turn depresses the trip lever. The override action of the carriage shift gear will cause the rearward movement of the trip link and the trip lever. As the trip lever moves rearward, the delatching lever is contacted and depressed to move the setting lever latch from under the gate setting lever.

The gate setting lever cannot trip because the tabulating restore cam has rotated so it holds the roller of the relatching lever (inset) until the shift cycle is completed, and then the relatching lever will drop off the tabulating restore cam and allow the entry of the add-subtract gate in minus.

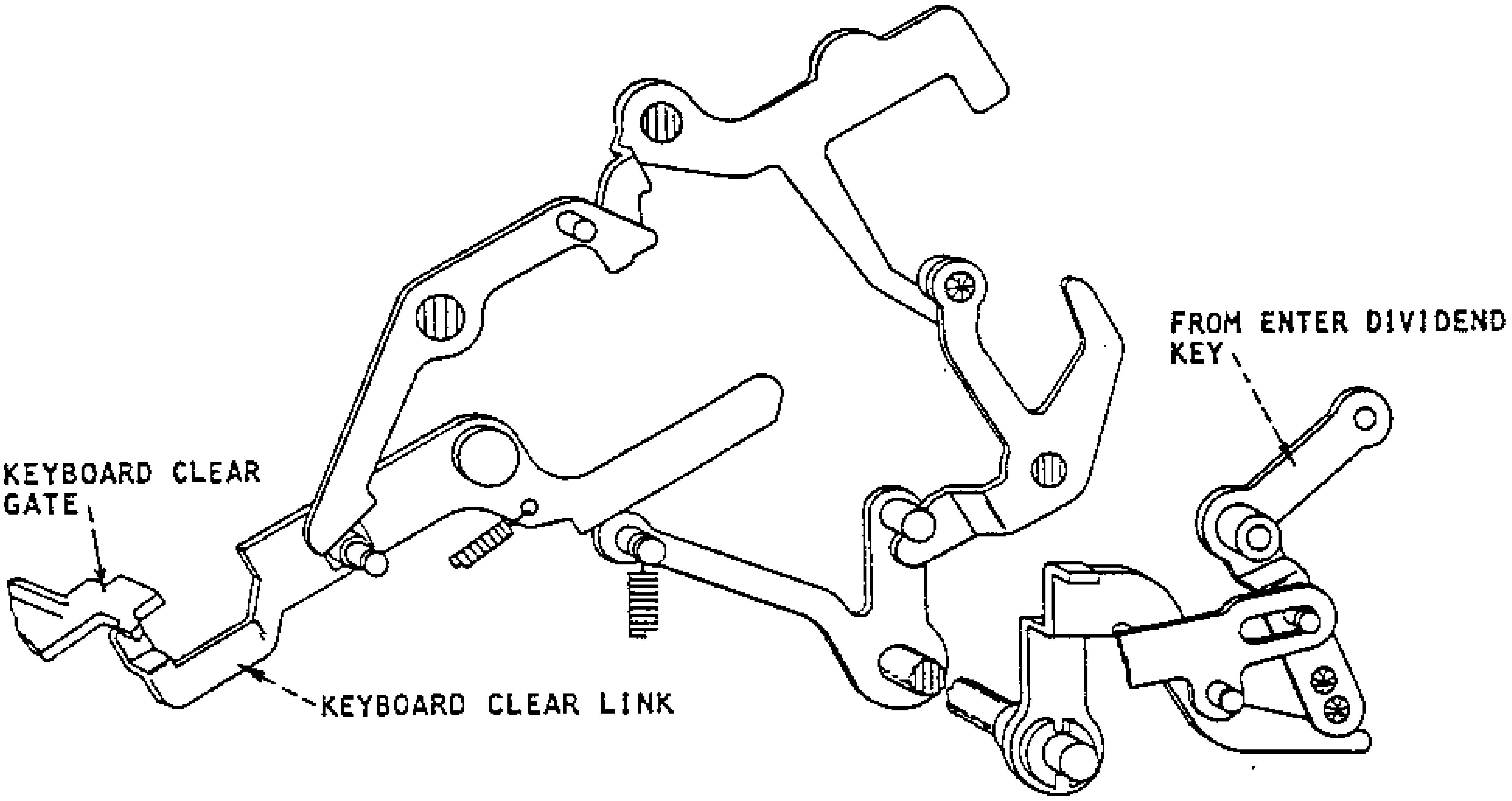


FIG 13. NO ACTUATION OF KEYBOARD CLEAR GATE AT END OF BACK TRANSFER OPERATION WHEN ADD KEY IS FORWARD:

During the back transfer operation, the keyboard clear link is held below the keyboard clear gate as a result of the enter dividend key depression. Just before the end of the last back transfer cycle, the enter dividend key is released, but the release is after the keyboard clear link has made its last rearward movement under the keyboard clear gate.

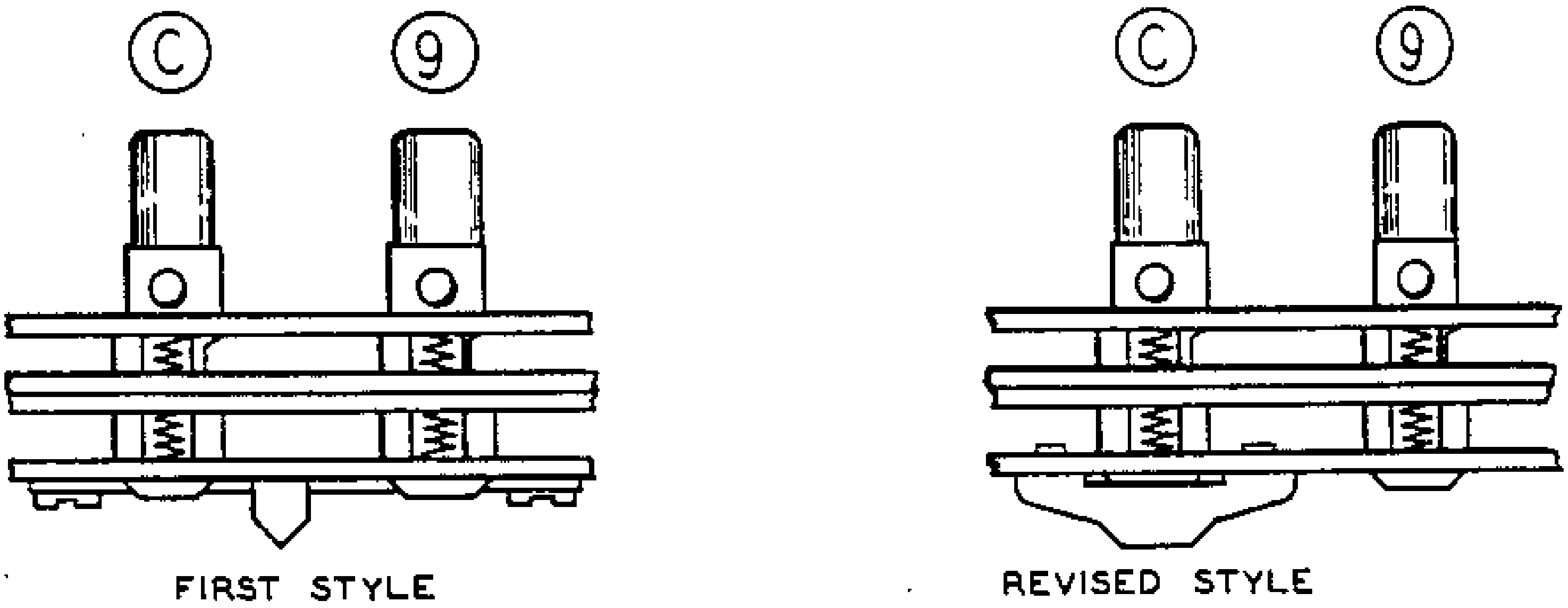


FIG 14. BACK TRANSFER OPERATION WHEN NO TAB STOP IS DEPRESSED:

The depression of any tab stop from 0 to 9 will cause a back transfer operation to occur when the carriage reaches the depressed tab stop. The left position C tab stop does not latch down since it is a release key for the other tab stops. When no tab stop is depressed during back transfer, the carriage will tabulate to the extreme right position and the machine will perform back transfer because the tabulation mechanism is tripped by an auxiliary stop on the underside of the front carriage rail between the C and the 9 tab stop.

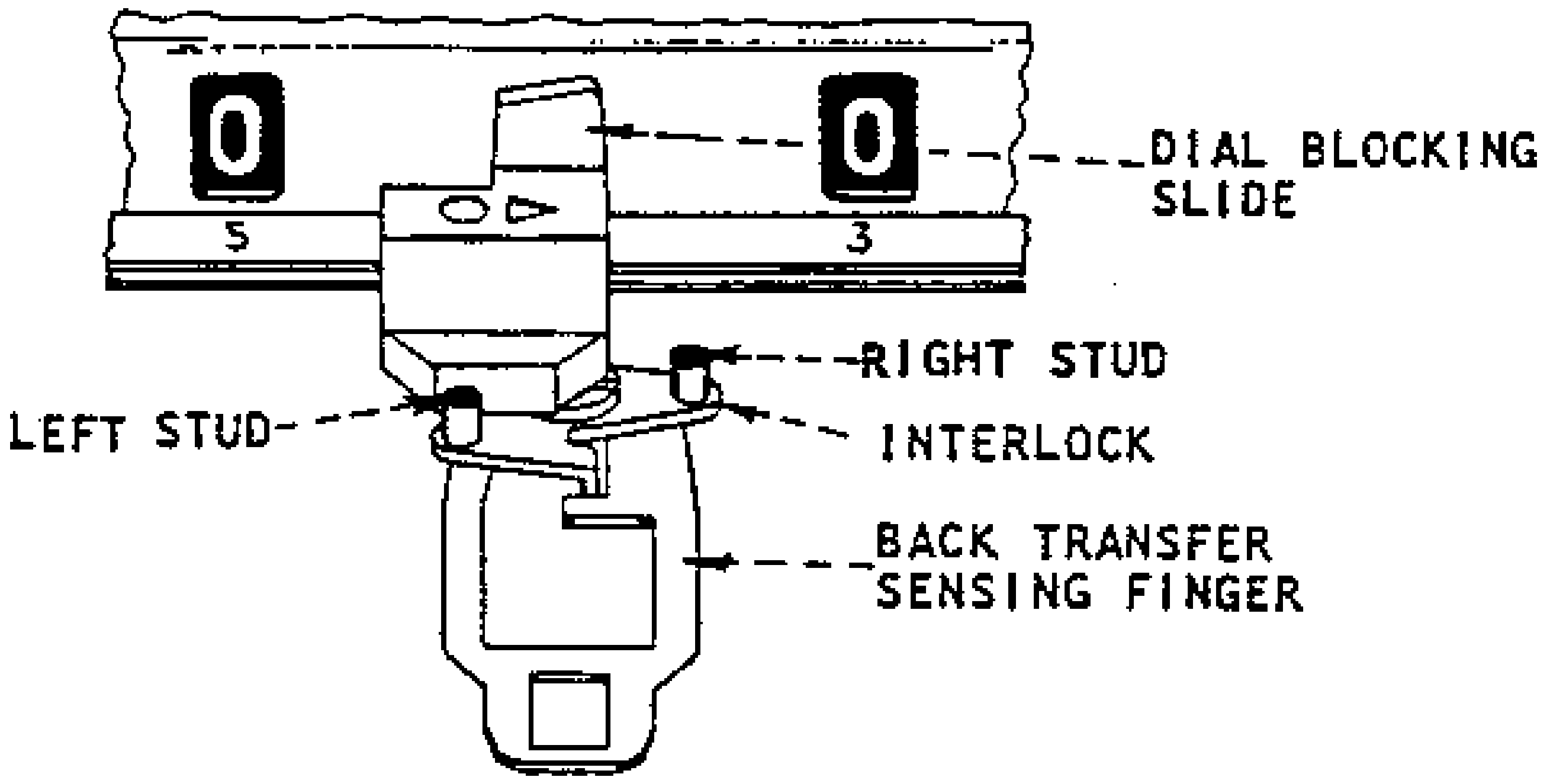


FIG 15. BLOCKING OF BACK TRANSFER SENSING FINGERS:

Located on the decimal bar is the dial blocking slide labeled by an arrow. This slide may be moved to cover any dial from the first to tenth position. When moved, it pivots an interlock to block the back transfer sensing fingers. When the slide covers a dial, a right stud is visible in front of that dial and also in front of the dials to the right of the slide. All dials in line with a right stud showing will not have their figures back transferred.

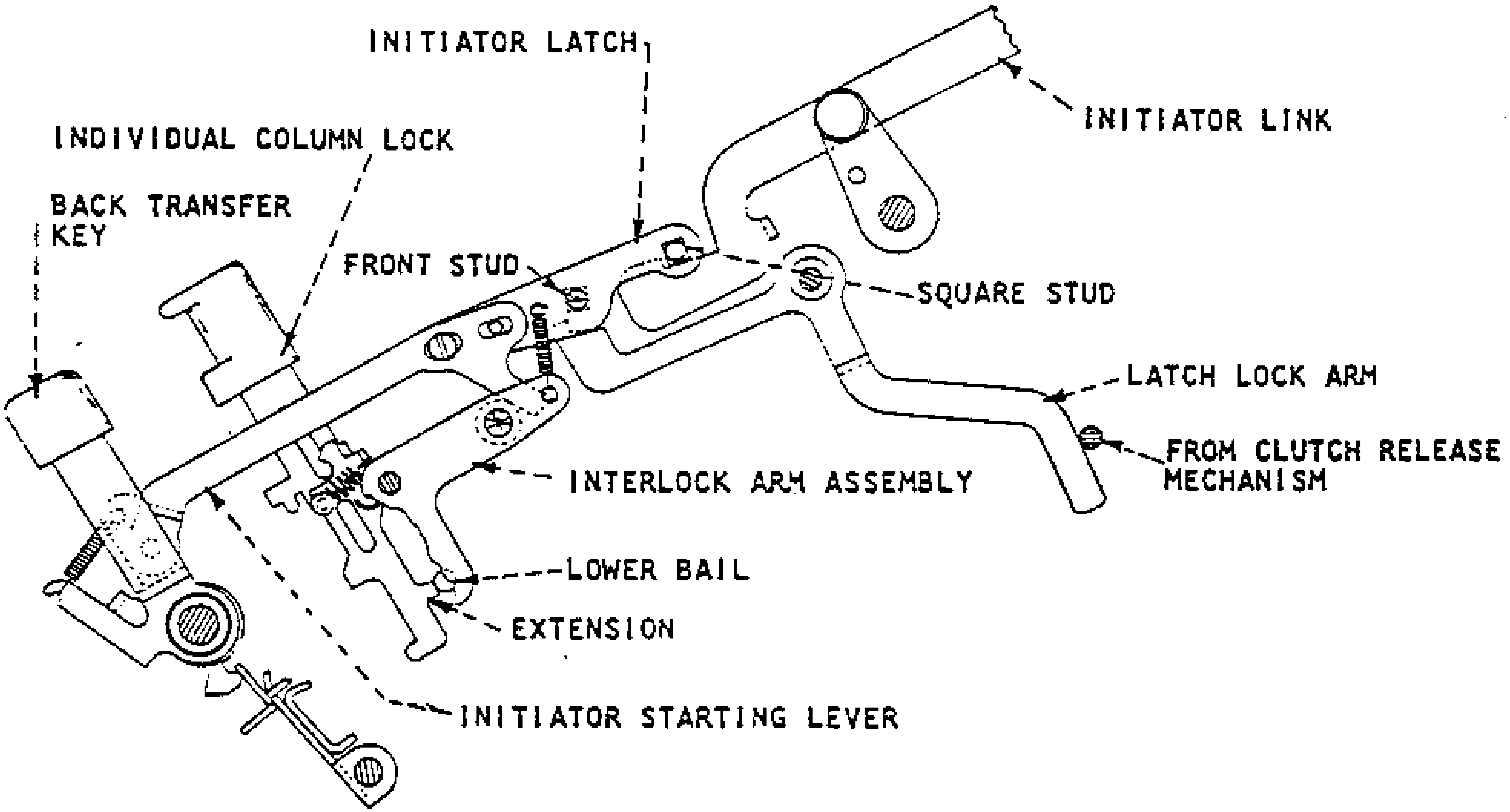


FIG 16. DISABLING OF BACK TRANSFER BY INDIVIDUAL COLUMN LOCKS AND FROM CLUTCH RELEASING:

Raising of an individual column lock will position an extension in line with the lower bail of the interlock arm assembly. When the back transfer key is pulled forward, the initiator starting lever will cam upward and raise the square stud over the initiator link.

Whenever the main clutch is released, the latch lock arm raises and interlocks the front stud of the initiator latch to prevent operation from the back transfer key.

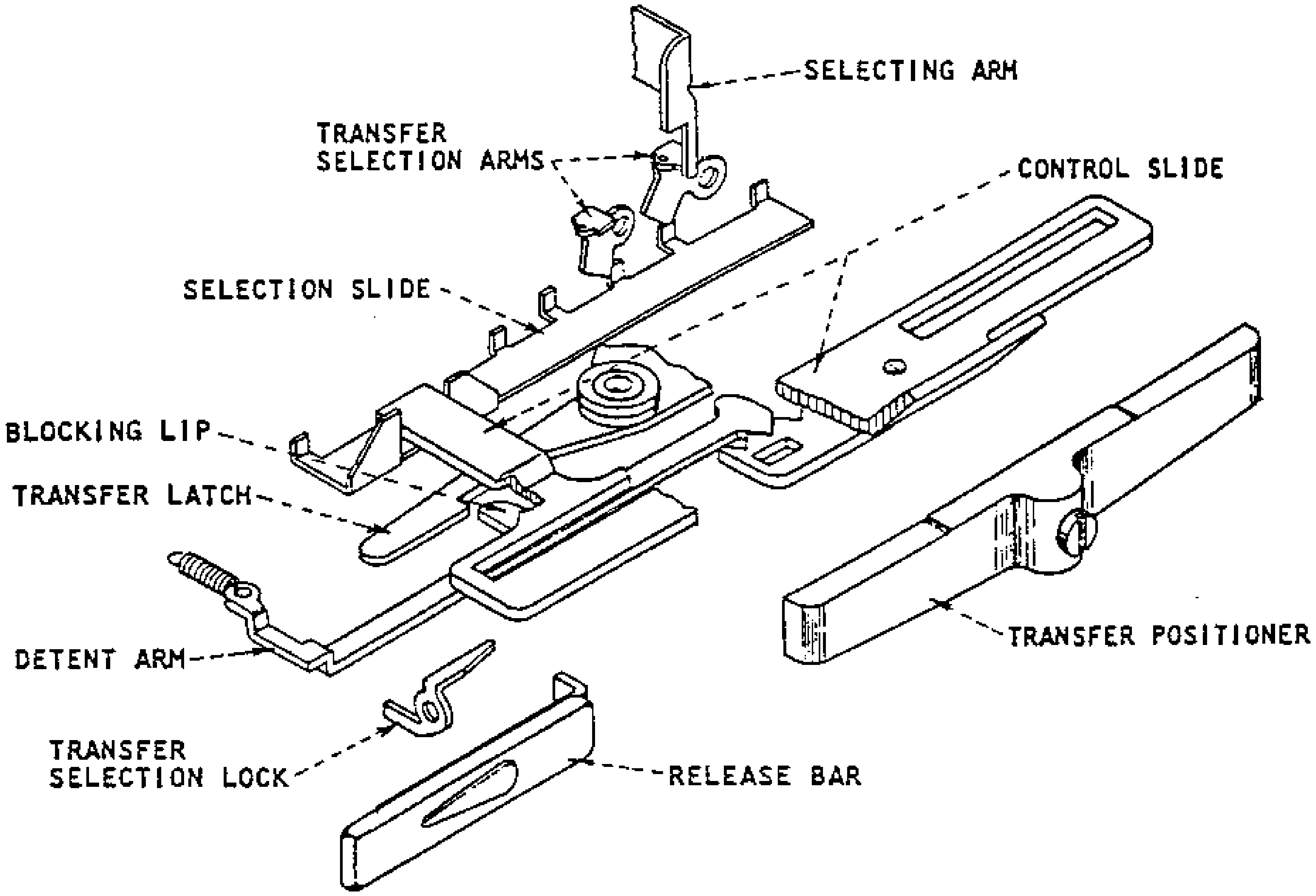


FIG 17. SELECTIVE TRANSFER POSITION:

By moving the release bar to the left and then moving the transfer positioner, the position of the 1 used in automatic transfer can be changed from the second to the tenth keyboard column.

The release bar actuates the transfer selection lock away from the left end of the detent arm. Moving the transfer positioner either to the right or to the left will move the control slide and the selection slide. The selection slide has eight teeth in staggered order that contact the transfer selection arms.

Moving the selection slide from left to right will position the transfer selection arms as such:

TRANSFER SELECTION ARMS	MOVED BY	TOOTH NUMBER
9th & 10th position	"	8
8th "	"	7
7th "	"	6
6th "	"	5
5th "	"	4
4th "	"	3
3rd "	"	2
2nd "	"	1

When the automatic transfer keys are depressed, the selection slide is rocked so the positioned transfer selection arm moves the standard selecting arm forward one selection position. The transfer latch is also moved forward and engages the locking lug of the detent arm to prevent movement of the transfer positioner during an operation.

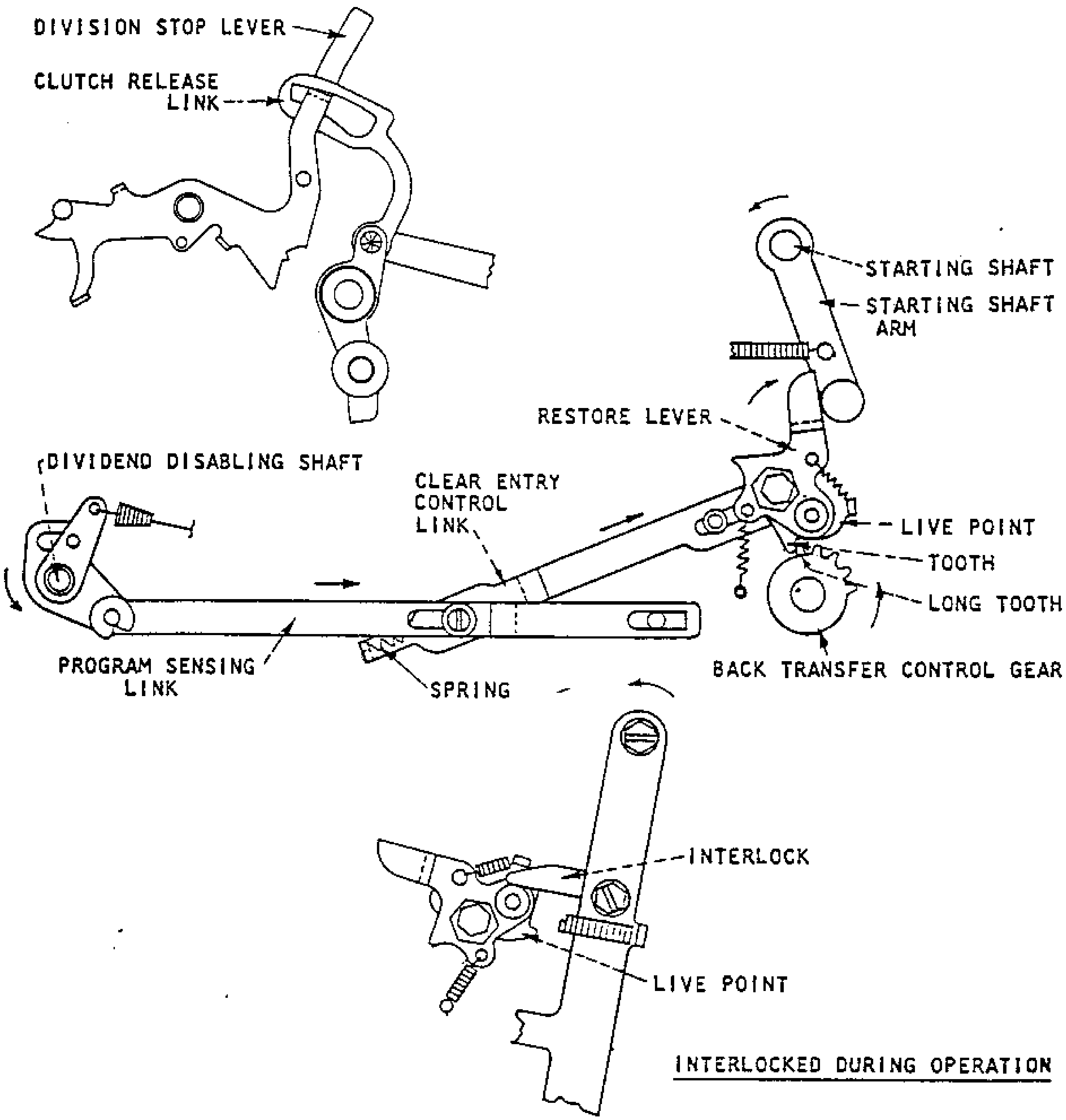


FIG 18. RESTORING OF STARTING SHAFT FROM DIVISION STOP LEVER:

Should the starting shaft become tripped and the machine fail to operate, the starting shaft can be restored easily by pushing rearward on the division stop lever.

Pushing the division stop lever rearward will cause: the releasing of the clutch through the clutch release link and, the rotation of the dividend disabling shaft. When the dividend disabling shaft rotates, it causes the program sensing link to move the clear entry control link forward. This action pivots the live point so its tooth comes into alignment for contact with the long tooth of the back transfer control gear.

When the long tooth actuates the live point, the restore lever moves the starting shaft arm forward and restores the starting shaft.

During a back transfer operation, the interlock swings into position to prevent the operation of the live point.

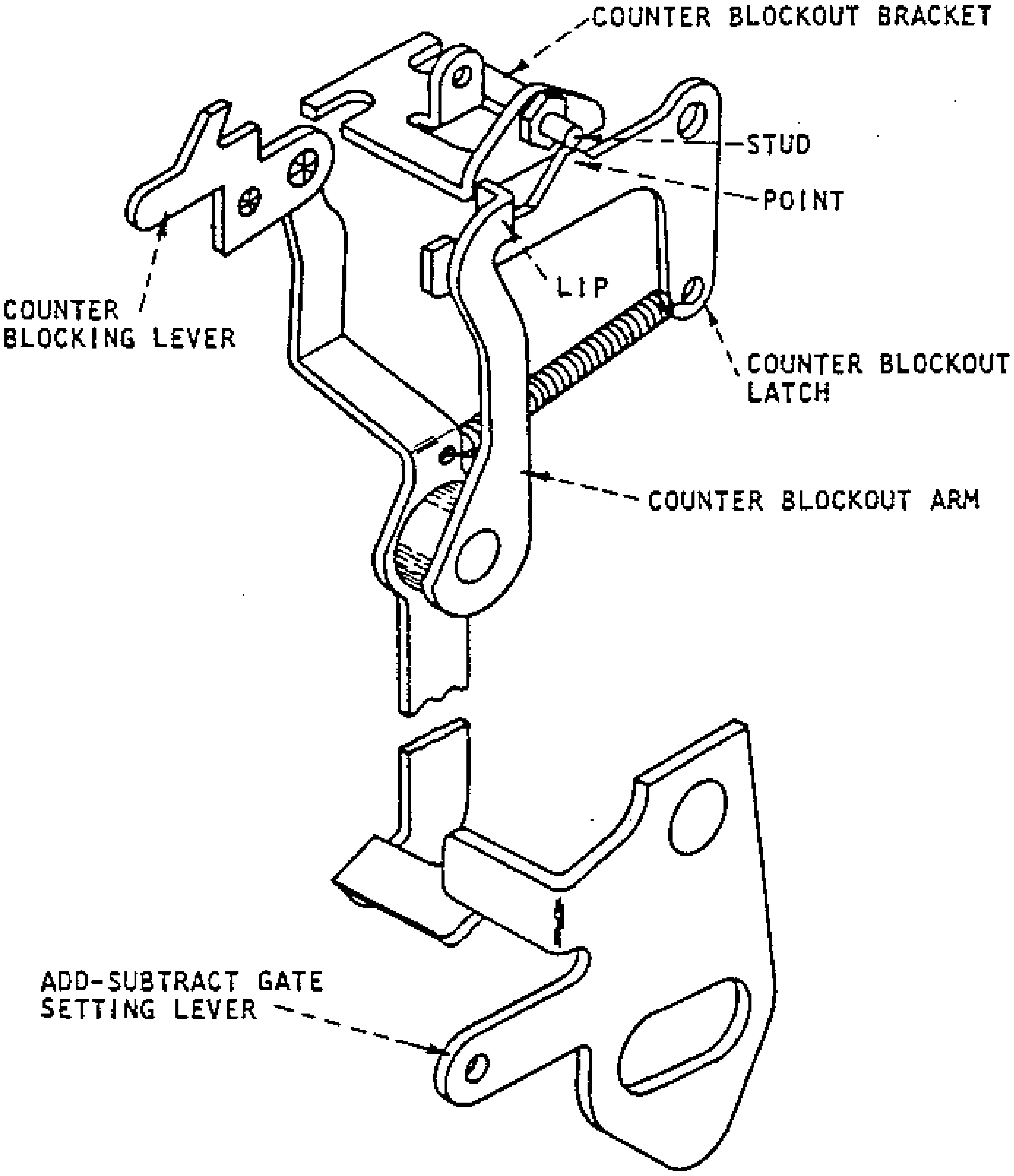


FIG 19. COUNTER BLOCKOUT:

The counter dials do not register during a back transfer operation because when the add-subtract gate is positioned in minus, the counter blockout arm and the counter blockout bracket move forward. The stud moves off the point of the counter blockout latch and the latch raises and engages the lip of the counter blockout arm. Thus, the counter blocking lever is held in blocking position when the add-subtract gate setting lever restores.

When the add-subtract gate centralizes, the stud depresses the counter blockout latch and releases the counter blockout arm. When this occurs, the counter blocking lever restores.

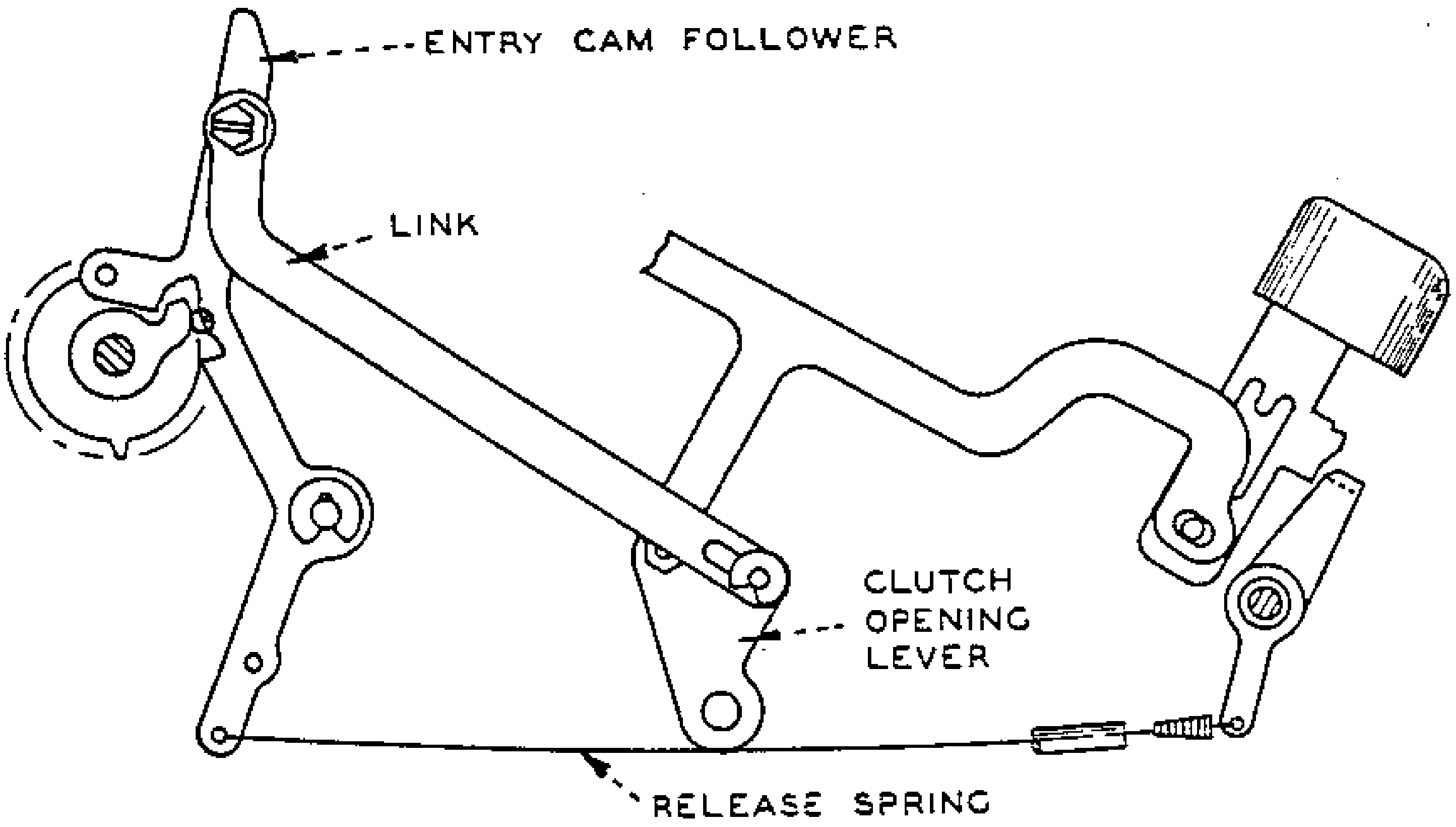


FIG 20. MULT KEY RESTORE:

During back transfer, the mult keys are not interlocked. Should a mult key be depressed during a back transfer operation when the add key is forward, the machine would give a mult cycle at the end of the back transfer and clear the storage. To prevent this, a release spring and a link were added. The release spring is pulled by the entry cam follower to actuate the mult key latch. The link is moved forward by the entry cam follower and pushed against the clutch opening lever which in turn pushes against the linkage to the mult keys. Should a mult key be held, the key will be pushed upwards.

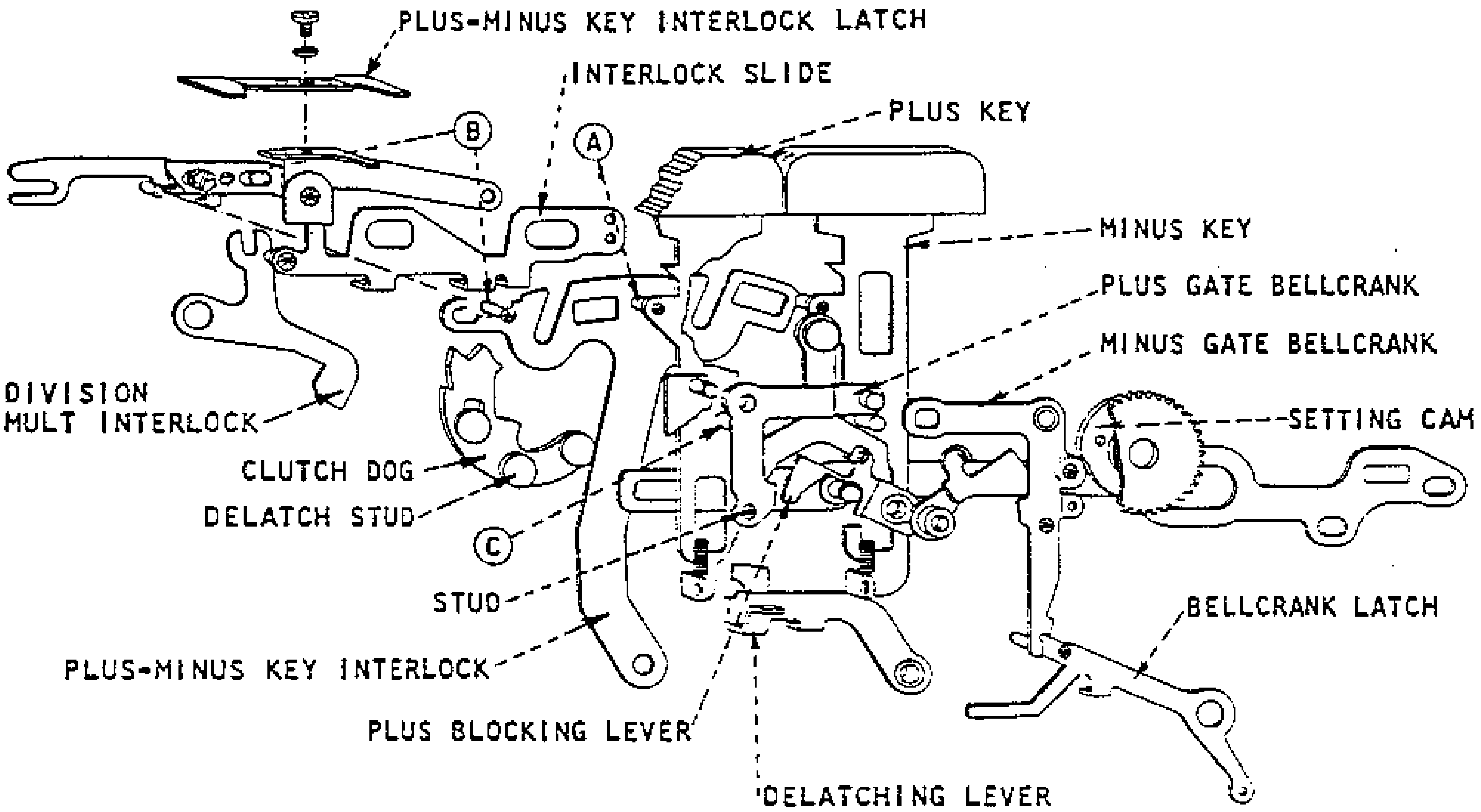


FIG 21. POWER SET OF ADD-SUBTRACT GATE:

The depression of the plus key:

1. Causes stud A to actuate the interlock slide to lock out the shift keys, the enter dividend key, and to position the division and mult interlock.
2. Causes stud A to actuate the plus-minus key interlock rearward to lock out the minus key. Rearward movement of the interlock causes stud B to release the clutch in the standard manner.
3. Causes stud C to depress the plus blocking lever.

The rotation of the drive shaft causes the setting cam to actuate the minus gate bellcrank which actuates the plus gate bellcrank so the stud pushes against the plus blocking lever. This lever is attached to the directional control slide, therefore, the slide is moved rearward and the add-subtract gate is positioned.

When the plus key is held down, the minus gate bellcrank is latched by the bellcrank latch to prevent oscillation of the directional control slide. When the key is released and the clutch dog opens, the delatch stud depresses the delatching lever to delatch the bellcrank latch.

The plus key is held down for the completion of the cycle by the plus-minus key interlock.

The actions on the depression of the minus key are similar, except the minus blocking lever is positioned therefore the gate is moved to the subtract position.